

two species the legs are neither modified nor adorned to any remarkable extent.

It must be understood that the few instances here given of the secondary sexual characters have been selected out of a number cited by the author, who could himself have filled a volume on the subject. Sufficient, however, have been given to show how commonly the anterior portion of the body varies in different ways in the male sex; and "it is of high importance to note that the bright-coloured hairs or metallic scales as well as the protuberances are either on the anterior surface, or in some way so placed as to be plainly in view from the front."

In seeking for an explanation of these sexual characters it does not appear that any of them are of special advantage to their possessors in the way of procuring food, avoiding enemies, fighting with rivals, &c.; consequently they cannot be attributed to the action of natural selection. But when considered in connection with the habits of the *Attidæ* at the time of mating, it is clear to the mind of the author that the clue is to be found in the theory of sexual selection. The courtship of a number of captive species is described, and described with a sense of the ludicrous which is quite irresistible. The following two may be selected as instances.

On p. 37 we read of *Sailis pulex*:—"On May 24, we found a mature female, and placed her in one of the larger boxes, and the next day we put a male in with her. He saw her as she stood perfectly still, twelve inches away; the glance seemed to excite him, and he at once moved towards her; when some four inches from her he stood still, and then began the most remarkable performances that an amorous male could offer to an admiring female. She eyed him eagerly, changing her position from time to time so that he might be always in view. He, raising his whole body on one side by straightening out the legs, and lowering it on the other by folding the first two pairs of legs up and under, leaned so far over as to be in danger of losing his balance, which he only maintained by sidling rapidly towards the lowered side. The palpus, too, on this side was turned back to correspond to the direction of the legs nearest it. He moved in a semicircle for about two inches, and then instantly reversed the position of the legs and circled in the opposite direction, gradually approaching nearer and nearer to the female. Now she dashes towards him, while he, raising his first pair of legs, extends them upward and forward as if to hold her off, but withal slowly retreats. Again and again he circles from side to side, she gazing towards him in a softer mood, evidently admiring the grace of his antics. This is repeated until we have counted 111 circles made by the ardent little male. Now he approaches nearer and nearer, and when almost within reach whirls madly around and around her, she joining and whirling with him in a giddy maze. Again he falls back and resumes his semicircular motions, with his body tilted over; she, all excitement, lowers her head and raises her body so that it is almost vertical; both draw nearer; she moves slowly under him, he crawling over her head, and the mating is accomplished."

Again, on p. 47, concerning *Dendryphantès elegans*:—"While from three to five inches distant from her, he begins to wave his plummy first legs in a way that reminds one of a windmill. She eyes him fiercely, and, he keeps at a proper distance for a long time. If he comes close she dashes at him, and he quickly retreats. Sometimes he becomes bolder, and when within an inch, pauses, with the first legs outstretched before him, not raised as is common in other species; the palpi also are held stiffly out in front with the points together. Again she drives him off, and so the play continues. Now the male grows excited as he approaches her, and while still several inches away, whirls completely around and around; pausing, he runs closer and begins to make his abdomen quiver as he stands on tip-toe in front of her. Prancing from side to side, he grows bolder and bolder, while she seems less fierce, and yielding to the excitement, lifts up her magnificently iridescent abdomen, holding it at one time vertical, and at another sideways to him. She no longer rushes at him, but retreats a little as he approaches. At last he comes close to her, lying flat, with his first legs stretched out and quivering. With the tips of his front legs he gently pats her; this seems to arouse the old demon of resistance, and she drives him back. Again and again he pats her with a caressing movement, gradually creeping nearer and nearer, which she now permits without resistance, until he crawls over her head to her abdomen, far enough to reach the epigynum with his palpus."

From these cases and the others that are given it is established

that the attitudes and antics of the males are such as to display to the best advantage whatever adornments they possess, and it is concluded that the female selects as her mate the male which pleases her best on account of some superiority over his fellows in adornment either of colour, or special outgrowths, or both. Hence is deduced the further conclusion that the sexual ornaments of the male result from the constant preference by the females of the best-decorated males. But it is obvious that this conclusion is open to the same criticism as that advanced against Mr. Darwin's explanation of the sexual ornamentation of, e.g., birds—namely, the criticism that the conclusion rests upon an inference and not upon a fact; and that the most important link in the whole chain of evidence is wanting—namely, the proof that the females select as partners the most beautiful males. This it will be remembered, is perhaps Mr. Wallace's strongest objection to the hypothesis of sexual selection; and when we consider all the cases that are quoted in this work it will be seen that many of those that are advanced as supporting this hypothesis are equally explicable by Mr. Wallace's views. Thus, although it is certainly the case that the females are as a rule the more powerful and more ferocious, yet, on the other hand, judging from the descriptions given of the contests and dances of the males, it seems to be this sex which excels in activity; and if activity be a criterion of high vitality we at once see the connection between high vitality and ornamentation. Again, from the fact that the female watches with attention the antics and gambols of the male, it is inferred that she is admiring the display of his agility and beauty: that, of course, may be the case, but it is not conceivable, considering the ferocity of her disposition, that she is merely on the alert to ward off an unwelcome advance, or is but awaiting a favourable opportunity to seize and destroy her persecutor? Or again, if it be asked why it is that the males perform the strange antics in the presence of the females if it be not for display, it may be answered that the excitement of the males, always great during the breeding season, attains to a maximum at that time in the society of the females, and shows itself in the performance of the strange antics that are so graphically described. The same objection may be made to the idea expressed on p. 41 that the seemingly terrible battles of the males are all sham affairs gotten up for the purpose of displaying before the females. The fact that the males fight when there is no female to watch them makes it more probable that the combats are due to playful excitability or genuine ferocity. And lastly, not only, as above stated, is there a lack of evidence to show that the female prefers as partner the most beautiful male; but, more than that, it appears that the success of one male over another in courtship may be attributed to excess of vigour. Thus, in the case of *Astia vittata*, a species in which there are two types of male, it is stated on p. 54 that "the *niger* form is much the more lively of the two, and whenever the two varieties were seen to compete for a female, the black one was successful. He is bolder in his manners . . ."

Thus Mr. Peckham has not yet brought forward a sufficient number of facts to carry to all minds that conviction of the truth of the theory of sexual selection which he feels himself. But whatever be the value of the criticisms here advanced, and of others that will doubtless be thought of, everyone will admit that the paper contributes a number of new and interesting facts to the subject of sexual adornment, and most of its readers will probably feel inclined to think that the balance of the evidence, so far as spiders are concerned, tends to support the explanation proposed by Mr. Darwin.

R. I. Pocock.

THE TERMINOLOGY OF HYDROLYSIS, ESPECIALLY AS EFFECTED BY "FERMENTS."

ALL who consider the meaning of words, and who desire, as far as possible, to remove ambiguity from the terms employed in denoting chemical change, must have felt some dissatisfaction with the nomenclature used, chiefly by physiologists, in describing and discussing the remarkable phenomena

¹ In connection with this passage it is necessary to explain that at the time it was written I was not aware that Mr. Poulton, in his new work on "The Colours of Animals," cites the case of *Astia vittata* as affording the strongest support to the theory of sexual selection; nor did I see Mr. Wallace's review of this work in NATURE of July 24 (p. 289) until after the present article had been sent to the publisher. Consequently I had no means of knowing what Mr. Wallace's opinion on the point might be—except in so far as his reply to Mr. Poulton is the only one that common sense would immediately suggest to any man who holds Mr. Wallace's views on sexual ornamentation, or who criticizes the subject without prejudging it. —R. I. P.

presented by the living cell and which attend digestion. As Messrs. Brown and Morris in their paper "On the Germination of the Gramineæ" (Chem. Soc. Trans. 1890, 458) have done me the honour to accept several of my suggestions, I venture to regard the opportunity as one which should not be lost of discussing the terminology of fermentation phenomena.

Changes such as a glucose undergoes when it is resolved into carbon dioxide and ethyl alcohol take place under the influence of the living organism, and there is every reason to believe only *within* the cell: they involve the formation of products containing in the gross neither more nor less than the original elements of the compound fermented; and when the products are compared with the compound from which they are derived, it is seen that their production in all cases involves the separation of carbon atoms which were directly united, and also considerable rearrangement of the constituent elements.

Changes such as that which cane-sugar undergoes on inversion take place not only within the cell but equally well without it under the influence of a substance which, although not living, is of vital origin: they appear always to involve the fixation of the elements of water; and the products of their action bear a very simple relation to the original substance, viz. always that of an alcohol to its ether, no separation of directly-united carbon-atoms, or any molecular rearrangement such as attends the former class of actions, taking place. The agents derived from organisms which effect changes of this second kind are spoken of as *unorganized ferments*; changes of the first kind are said to be conditioned by *organized ferments, i.e. organisms*.

There is thus, at the outset, a difficulty in assigning a consistent meaning to either term—fermentation or ferment; diverse phenomena produced by diverse agents being included under a single designation.

Fermentation.—The difficulty is in part met by restricting the term fermentation to changes such as occur, for example, during alcoholic fermentation; and there would seem to be no occasion to apply it more widely so as to include changes of the second kind, these, as before remarked, being apparently all cases of *simple hydrolysis*. This is true, even if the explanation of fermentation suggested by Baeyer in 1870 (cf. *Ber.*, 1870, 63; *Journal of the Chemical Society*, 1871, 331) be accepted, which represents fermentation proper as the outcome of hydrolysis—an explanation which the increase of knowledge in the interval entirely favours; inasmuch as hydrolysis takes place in the two cases with different results, and affects compounds of different types. Moreover, it is to be noted that not only is it impossible to represent the phenomena of fermentation proper as the outcome of simple hydrolysis, but that also, in certain cases, synthetic as well as analytic changes occur; in the case of butyric fermentation, for example. In fact, in many instances, apparently two series of concurrent changes take place: the one series involving what, in the light of Baeyer's explanation, may be termed *recurrent* as distinguished from *simple* hydrolysis; the other involving the interaction of the molecules of one or more products of this recurrent hydrolysis. There is thus an advantage in employing a somewhat empirical expression in connoting phenomena which do not all conform to one absolute type, but which have a common origin, as they are the outcome of protoplasmic activity, especially as most fermentations are attended with evolution of gas.

But it is to be remembered that, whereas carbohydrates and allied compounds such as glycerol, lactic acid, &c., are said to undergo *fermentation*, the decomposition of albuminoids under the influence of organisms is commonly termed *putrefaction*; this distinction, however, is made on account of the character of the products, not because there is any reason to suppose that the changes which occur are essentially different in character from those which the carbohydrates undergo. The want of a term indicative of the fact that the action is one which takes place under vital influence without reference to the character of the change—equally applicable to simplifications such as occur during alcoholic fermentation and to complications such as occur during butyric fermentation—is also felt in the case of changes such as alcohol undergoes under the influence of *Mycoderma aceti* and *vini*, or which ammonia undergoes on nitrification, and in the converse change of denitrification. Dr. W. Roberts has proposed to speak of changes induced by enzymes (*v. infra*) as cases of *enzymosis*; the corresponding term *zymosis* might well be employed as the synonym of fermentation, and would probably be found to be of more general application: thus alcohol may be said to undergo oxidation by *zymosis* or *zymic* oxidation under the influence of *Mycoderma aceti*; and in discussing putrefactive

changes, it would be possible to speak of *zymic* changes as distinct from those arising from the unassisted interaction of the *zymic* products. *Zymosis* is preferable to *zymolysis*, as the effect is not always one of simplification.

Ferments.—The expression *ferment* is more frequently than not employed as the equivalent of *unorganized ferment*; consequently it is applied to the very agents which are incapable of producing fermentation proper. This has been so generally felt to be the case that several words have been coined in place of unorganized ferment, notably *zymase* and *enzyme* (cf. Dr. W. Roberts, Roy. Soc. Proc., 1881, xxxi. 145): the objection may be made to the former that it is indicative of vitality; the latter, however, is expressive, and serves only to indicate the vital origin of the agent, thus differentiating it from agents such as the mineral acids which act very similarly.

Enzymic action or *enzymosis*¹—to use the phrase suggested by Dr. Roberts—appears, as already remarked, always to involve decomposition by means of water. On this account, in 1880, in the second edition of my "Introduction to the Study of Organic Chemistry" (Longmans; footnote, p. 190) I put forward the following suggestions:—

"Decompositions like those of starch into dextrose, of cane-sugar into dextrose and levulose, of the fats into glycerine and an acid, or of ordinary ether into ethylic alcohol, which involve the fixation of the elements of water, may all be said to be the result of *hydrolysis*; and those substances which, like sulphuric acid, diastase, emulsin, &c., induce hydrolysis may be termed *hydrolytic agents* or *hydrolysts*. The substance hydrolyzed is the *hydrolyte*. The mere fixation of the elements of water, unaccompanied by decomposition, as in the conversion of ethylenic oxide into glycol, $C_2H_4O + OH_2 = C_2H_4(OH)_2$, may be termed *hydration* in contradistinction."

It is usually necessary to employ a specific enzyme (hydrolyst), or one of a very limited number, to effect the hydrolysis of any particular hydrolyte, and hence physiologists are in the habit of speaking of *amylolytic* ferments, *proteolytic* ferments, &c., meaning ferments capable of *splitting up* starch, proteids, &c. But the terms amylolytic, proteolytic, &c., are confusing to the student who has learnt that electrolysis signifies *splitting up by means of* electricity, and hydrolysis *splitting up by means of* water—not the *splitting up of* electricity or of water. As electrolysis and even hydrolysis are well-established terms which it would scarcely be politic to alter, it appears highly desirable to abandon the use of terms such as amylolytic, proteolytic, &c., and I would suggest that an enzyme capable of inducing the hydrolysis of starch should be termed an *amylolytic*; one which affects albuminoids, a *proteid-hydrolyst*; one which affects fats, a *glyceride-hydrolyst*.

One case remains in which the use of the term ferment cannot be avoided by the adoption of this proposition—that of the so-called rennet ferment. It may well be that this is also a hydrolyst, and that in all cases the formation of a curd, clot, or coagulum initially involves hydrolysis—or, perhaps, hydration merely—and the consequent interaction of molecules of the product or products; but of this we know nothing at present, and the observed phenomena are of so different a character that it is desirable to connote such changes by a distinct expression. I would suggest that we should term the rennets *thrombogenic enzymes* or *thrombogens*.

HENRY E. ARMSTRONG.

SCIENTIFIC SERIALS.

L'Anthropologie, sous la direction de MM. Cartailhac, Hamy, et Topinard, tome i., No. 2 (Paris, 1890).—The covered mortuary-chambers at Les Mureaux (Seine-et-Oise), by Dr. Verneau. Through the accidental displacement of the soil in a field at Les Mureaux an important discovery was made in the winter of 1888-89 of a subterranean sepulchral passage, a so-called *allée couverte*, which was densely packed with human bones, intermingled with various stone, bone, and other objects. As in other constructions of the kind, this mortuary passage was divided into two paved and walled-in chambers, varying in width from 1.85 m. to 2.10 m. Owing to the thickness of the stone walls dividing these chambers, considerable labour must have been required to effect an entrance whenever a fresh burial took place. It would appear that sixty or more skeletons had been deposited in these chambers, but unfortunately many

¹ Sheridan Lea's *zymolysis* (cf. *Journal of Physiology*, 1890, xi. 254) is open to the objection above made to *zymase*.